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UNIQUE PERSPECTIVES
ON A TRANSFORMING ENERGY ECONOMY

2014 ANNUAL REPORT

JISEA.ORG

WHAT MAKES JISEA UNIQUE?

UNIQUE PERSPECTIVES.

That is what the Alliance for Sustainable Energy sought when it launched the Joint Institute for Strategic Energy Analysis in conjunction with the National Renewable Energy Laboratory, University of Colorado-Boulder, Colorado School of Mines, Colorado State University, Massachusetts Institute of Technology, and Stanford University.

These institutions joined with a mission to provide thought-provoking yet thoughtful analysis of energy technologies and energy systems and undertake efforts that have a material impact on the national energy agenda and on energy systems transformation.

JISEA IS DELIVERING ON THAT MISSION. IN THE PAST YEAR, JISEA:

- Matured the 21st Century Power Partnership through entering a strategic partnership with the Children's Investment Fund Foundation. With this new engagement and continued support from the Clean Energy Ministerial Secretariat, JISEA is helping to establish the Power Partnership as a trusted player in the power systems transformation space. In 2013, the Power Partnership published an eye-catching examination of how coal can play a part in lower carbon energy sector and provided practical, on-the-ground assistance to advance renewables in South Africa, India, and Mexico.
- Continued to seed innovative, trans-disciplinary research among our founding partner institutions in areas such as energy security, the nexus of energy/food/water/land/climate change, and integrated energy systems.
- Expanded our reputation for thought leadership in the field of natural gas/renewable energy synergies with a conference and report on business models for capturing value streams in hybrid energy systems.
- Gained critical sponsorship support to launch, in conjunction with our partner universities, the next phase of our natural gas research. These efforts will focus on greenhouse gas emissions, power, transport, and water use.

These successes demonstrate recognition for the value of JISEA's multi-institutional structure, which gives JISEA unique perspective on the connections between energy sources, supply chains, policies, markets, and people.

Throughout this brochure, we showcase JISEA's unique perspectives through our recent accomplishments and the people behind them.

JISEA has much to celebrate this year and is poised for continued success as a provider of insights to help guide a transforming energy economy.

"Systems thinking" is an essential discipline for seeing growing connections between energy, environment, and economy. JISEA provides big picture insights that help policymakers and energy planners understand the impacts of existing and proposed legislation, policy, and investments on renewable energy development and deployment at the local, state, regional, national, and global levels.



Bobi Garrett

Executive Committee Chair // Deputy Laboratory Director, Strategic Programs and Partnerships // Alliance/NREL



Douglas J. Arent, MBA, Ph.D.

Executive Director, Joint Institute for Strategic Energy Analysis // Acting Director, Strategic Energy Analysis Center // NREL

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An aerial night view of a city skyline, likely Manila, Philippines, featuring prominent skyscrapers like the One World Trade Center. The image is overlaid with a blue network of white lines and dots, symbolizing connectivity and technology. The title text is in large, bold, white capital letters.

UNIQUE PERSPECTIVES

ON A TRANSFORMING
ENERGY ECONOMY



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jisea.org/news.cfm#npr

SLASHING FUEL CONSUMPTION COMES WITH A PRICE

Excerpted from NPR's *All Things Considered*

When National Public Radio's *All Things Considered* wanted to know if it is possible to create a U.S. electric system that provides stable power with as much as 80% renewable resources, the program turned to JISEA's Doug Arent for answers.

Governments around the world are seeking a new agreement to address anthropogenic climate change. Reducing carbon output by up to 80% by mid-century from sources like coal, oil and natural gas, which emit carbon dioxide into the air, is a critical component of any response strategy.

Nations are far from that ambitious path. There are big political and economic challenges. But technologists do see a way—at least for the United States—to achieve that goal.

Nowhere is that aspiration clearer than at the National Renewable Energy Laboratory.

People have been dreaming about clean energy for decades. And for decades, the world has relied overwhelmingly on the much cheaper fossil fuels. Coal, oil and natural gas made up 82 percent of total energy consumed 25 years ago, and they still make up 82 percent of the world's energy diet today.

To find out what it would take to budge from that mark, I sat down with the National Renewable Energy Lab's Douglas Arent.

Arent co-authored a major study to look at a piece of this challenge. It asked whether the United States could move away from coal and gas, and instead rely on wind, solar and other renewable energy supplies for at least 80 percent of the nation's electricity by the middle of this century.

"Our results, from a technical nature, show that you could meet demand every hour of the year, with up to 80 percent of it coming from renewable resources," Arent says.

"Our results, from a technical nature, show that you could meet demand every hour of the year, with up to 80 percent of it coming from renewable resources," Arent says.

Not to say it would be easy.

"The grid would have to be much more flexible," Arent says. "The utility model of the future would have to look different. And of course, in the economically ideal case, we would build much more transmission."

Those new transmission towers might prove too expensive, or they might generate local opposition. If that happens, Arent says, we'd

need to find a way to store a huge amount of renewable power so it can be used when it's needed.

"What we found was that there were many pathways, and there

» CONTINUE

JISEA'S GLOBAL TEAM



Douglas Jay Arent, MBA, Ph.D.

Executive Director

Doug Arent specializes in strategic planning and financial analysis competencies; clean energy technologies and energy and water issues; and international and governmental policies. In addition to his NREL responsibilities, Arent is a Senior Visiting Fellow at the Center for Strategic and International Studies. Arent was appointed as a Coordinating Lead Author for the 5th Assessment Report of the Nobel Prize winning Intergovernmental Panel on Climate Change (IPCC) and serves on the National Research Council Committee to Advise the U.S. Global Change Research Program.

JISEA'S GLOBAL TEAM



Morgan Bazilian, Ph.D.

Deputy Director

Morgan Bazilian joined JISEA with two decades of experience in the energy sector ranging from upstream oil and gas policy to the design of fiscal instruments to promote clean energy. Before joining JISEA, Bazilian was the Senior Advisor to the Director-General of UNIDO on international energy and climate policy. In this role he helped shape the United Nations approach to energy for development and managed the UN's interagency energy mechanism—UN-Energy.

wasn't a red flag that said it was impossible, at least at the level that we looked at it," Arent says.

At Stanford University, Sally Benson heads the Global Climate and Energy Project. She challenges her students to think of reducing emissions from all energy sources—not just electricity, but transportation fuels, gas furnaces and industrial processes.

The solution the students inevitably arrive at requires steady, reliable and large-scale sources of clean energy. It also means producing a substantial amount of nuclear power.

"It's definitely an all-of-the-above strategy," Benson says. "You have to do all of them at a really significant pace, and you need to be reducing carbon emissions and your energy use."

So, is she optimistic?

"I think there's lots of good news on the technology side, and I think [many of] the smartest engineers and scientists at universities around the world ... are focused on this challenge," she says. "So from that perspective, I am quite optimistic."

LINKING ENERGY INDEPENDENCE TO ENERGY SECURITY

Adapted from paper published in International Association of Energy Economics *Energy Forum*.

"Energy independence" is an appealing goal, but given realities of domestic energy markets and geopolitics, it may not be a realistic one.

Dramatic changes in oil and gas production in the United States have resurrected interest in "energy independence." This attraction likely stems in part from a connotation that "independence" equals resiliency and stability of energy services without risk of volatility.

However, both domestic energy issues and geopolitics are considerably more interrelated than this argument allows. In addition, the vocabulary used is often

imprecise. We argue that although politically seductive, the idea of energy independence can distract from sound decision making in the energy sector.

The case against relying on energy independence as a policy prescription tends to look at the end goals of energy policy, and describes resiliency and stability of energy services not as ends themselves, but rather as means of economic growth, innovation, and social well-being.

Some degree of enthusiasm is warranted. In the United States, energy independence is commonly defined in terms of the degree of reliance on imports from outside North America, and falling imports have made independence appear attainable. The past five years have witnessed a sea change in the proven reserves and the production of oil, natural gas, and natural gas liquids in the United States.

A far larger set of considerations are critical to inform energy policy.



The concepts and methodologies from the “energy security” literature provide firmer grounding for policymaking.

Google searches for the term “US energy independence” begin spiking in early 2012, reflecting a resurging interest in the topic.

Energy security requires a rigorous aggregation of dozens of variables that impact energy flows in the real world. John Elkind in 2010 argued that energy security is composed of:

- **Availability**—the ability for consumers and users to secure energy
- **Reliability**—the extent that energy services are protected from disruption
- **Affordability**—low or equitable and stable prices relative to income

- **Sustainability**—minimizing social, environmental, and economic damage.

The simplifications that come with the energy independence frame can promote sub-optimal policy choices if they fail to acknowledge the complexity of energy security and wider considerations of geopolitics and markets.

The future could bring more globally interdependent markets and systems. As a result, the pillars of robust U.S. energy policy could

include an embrace of global partners, a wise optimization of the bounty of oil and gas in North America toward sustainable patterns of consumption and use, and close consideration of the possible synergies between fossil fuels and renewable energy resources.



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iaee.org/en/publications/newsletterdl.aspx?id=200



With this study and our larger body of work focusing on natural gas, JISEA offers policymakers and investors a solid analytical foundation for decision making.

METHANE EMISSIONS FROM NATURAL GAS SYSTEMS INDICATE NEW PRIORITIES FOR NATION

Study findings published in the journal *Science*.

Because natural gas emits less carbon dioxide during combustion than other fossil fuels, it has been touted as a 'bridge' fuel to a lower carbon energy system. But a new study published in the journal *Science* says that the total impact of switching to natural gas depends heavily on leakage of methane (CH₄) during the natural gas life cycle and finds that current evidence suggests leakages are larger than official estimates.

The article presents a first effort to systematically compare North American emissions estimates at scales ranging from device-level to continental atmospheric studies. Work was organized by Novim with funding from the Cynthia and George Mitchell Foundation and led by Stanford University's Adam Brandt. "Methane Leakage from North American Natural Gas Systems" features JISEA and JISEA

founding partner members among its international team of authors.

"Recent life cycle assessments generally agree that replacing coal with natural gas has climate benefits," said Garvin Heath, a senior scientist at NREL and a lead author of the report. "We identified cause for concern but found that system-wide leakage is unlikely to be large enough to disfavor coal-to-natural gas substitution."

"With this study and our larger body of work focusing on natural gas, JISEA offers policymakers and investors a solid analytical foundation for decision making," said Doug Arent, co-author to the study.

AMONG OTHER FINDINGS OF THE RESEARCH:

- Official inventories of methane leakage consistently underestimate actual leakage.

- Evidence at multiple scales suggests that the natural gas and oil sectors are important contributors.
- Independent experiments suggest that a small number of "super-emitters" could be responsible for a large fraction of leakage.
- Recent regional atmospheric studies with very high emissions rates are unlikely to be representative of typical natural gas system leakage rates.
- Hydraulic fracturing is not likely to be a substantial emissions source, relative to current national totals.
- Abandoned oil and gas wells appear to be a significant source of current emissions.



LEARN MORE

<http://www.sciencemag.org/content/343/6172/733.summary>



BUSINESS OPPORTUNITIES FOR UNITING NATURAL GAS AND RENEWABLES ABOUND AT SYSTEM AND SECTOR LEVELS

To support the U.S. need for cleaner energy sources now and in the long term, a study by JISEA identifies compelling business models that build from the synergies of two abundant, domestic forms of energy: natural gas and renewable energy.

Natural gas and renewable energy each contribute to economic growth, energy independence, and carbon mitigation, sometimes independently and sometimes collectively. In a growing body of work, JISEA examines ways these two domestic forms of energy can work in greater concert.”

A 2014 paper, *Exploring the Potential Business Case for Synergies between Natural Gas and Renewable Energy*, identifies revenue opportunities that emerge from systems-level perspectives in “bulk energy” (large-scale electricity and natural gas production, transmission, and trade) and four “distribution edge” subsectors: industrial, residential, commercial, and transportation end uses.

“To advance a cleaner, decarbonized energy system, we have to look at energy and economic systems in new ways. With this study, JISEA provides a

valuable and unique perspective on collaboration rather than competition between natural gas and renewables, and practical insights that can help spur the clean energy economy,” said former Colorado governor Bill Ritter, Jr., director of the Center for the New Energy Economy (CNEE) at Colorado State University. CNEE and JISEA co-hosted a workshop to gather expert input on the business models for gas and renewables.

ADVISORY COUNCIL

JISEA is forming an external Advisory Council to help ensure that its work has a material impact on national and global energy issues. The council will also provide advice on how to strengthen the distinctiveness and value of JISEA's capabilities. Initial members include:

Joan MacNaughton

Executive Chair, World Energy Trilemma, World Energy Council

Bill Ritter

Director, Center for the New Energy Economy, Colorado State University

Katherine Sierra

Senior Fellow, The Brookings Institution



LEARN MORE
JISEA.org/natural_gas.cfm
nrel.gov/docs/fy14osti/60052.pdf



JISEA looks beyond either/or solutions for decarbonizing the energy sector and engages in the practical work of achieving that goal in an “all of the above” world.

HYBRID NUCLEAR/RENEWABLE SYSTEMS CAN PROVIDE SECURE, RELIABLE, AFFORDABLE, LOW-CARBON ENERGY

In a paper published in *Energy Conversion and Management* (Vol. 78, Feb. 2014), JISEA explores a potential concept for providing low-carbon and secure, reliable, affordable energy—hybrid operation of nuclear reactors coupled with renewable energy technologies and industrial processes in a single facility.

“As energy systems move toward lower carbon energy, significant additions of variable renewable generation such as wind and photovoltaic power are likely,” said JISEA’s Morgan Bazilian, co-author of the article.

“Continued integration of variable renewable resources drives the need for flexible generation to accommodate fluctuations in supply and demand.”

Advanced informatics, energy management systems, and forecasting are enabling new innovation in integrated plant design and power system operations and can be utilized to design new types of hybrid energy systems that:

- Allow traditional base-load systems to generate economical load-following power

- Improve grid flexibility and allow for multiple types of ancillary services
- Produce additional commodities such as fuels for the transportation sector.

Authors identified opportunities, interconnections, and needs, and explored interface and system-level issues including ownership, regulatory, design, construction, and operational issues.



LEARN MORE
[sciencedirect.com/science/article/pii/S0196890413007516](https://www.sciencedirect.com/science/article/pii/S0196890413007516)



The 21st Century Power Partnership aims to accelerate the global transformation of power systems. The multilateral effort of the Clean Energy Ministerial serves as a platform for public-private collaboration to advance integrated policy, regulatory, financial, and technical solutions for the large-scale deployment of renewable energy in combination with deep energy efficiency and smart grid solutions.

As the operating agent for the Power Partnership, JISEA implements Power Partnership activities based on guidance from the Clean Energy Ministerial, the United Nations, and other partners and stakeholders. JISEA is also engaged on behalf of the Power Partnership in 'on the ground' activity to increase renewable penetration in South Africa, Mexico, and India.



LEARN MORE
21stCenturyPower.org

FLEXIBLE COAL PLANTS CAN PLAY A PART IN 21ST CENTURY POWER SYSTEMS

Globally, new economic and political circumstances are reshaping power systems in favor of those that operate with greater flexibility and efficiency and incorporate renewable energy and demand response. Coal, which is widely perceived to provide only baseload power generation, remains a critical component in most power systems. Coal generation plants can be modified to fit within the new power sector and be a part of a cleaner energy system.

A new report, *Flexible Coal: Evolution from Baseload to Peaking Plant*, summarizes the findings from a coal generating station that has been modified to operate more flexibly, with the ability to cycle on and off daily and run at low generation levels. The report was prepared by analysts from NREL and Intertek for the 21st Century Power Partnership.

"This study proves that coal can be part of a power system with high levels of renewable energy," said NREL's Jaquelin Cochran, a lead

author of the report. "Coal plants can be modified to respond to the changing output of renewable energy and run at low levels when renewable electricity generation is high but demand is low, such as at night. There is a cost to this flexibility, but these costs can be minimized with strategic modifications and maintenance."

The power sector's transition to greater penetration levels of renewable energy, demand response, and other emerging technologies requires flexibility in terms of power generation; it will favor plants that can cycle on and off multiple times per day and be turned down to low levels.

The ability of other coal plant operators to replicate the flexibility of the studied plant will be instrumental in valuing coal in an increasingly low-carbon energy system, according to the study.

"Older coal units can still serve a purpose if they are operated flexibly," said Cochran.



LEARN MORE
nrel.gov/docs/fy14osti/60575.pdf

MARKET EVOLUTION:

Wholesale Electricity Market Design for 21st Century Power Systems

The 21st Century Power Partnership established thought leadership with this review of wholesale power market designs in use and under consideration to ensure adequacy, security, and flexibility in a landscape of significant variable renewable energy.



LEARN MORE
nrel.gov/docs/fy14osti/57477.pdf

ENERGY SYSTEMS INTEGRATION: A CONVERGENCE OF IDEAS

Our energy system includes not only renewable, nuclear, and fossil energy sources but also electrical, thermal, and fuel energy pathways that convert and deliver energy services at different physical scales. Interactions and interdependencies are increasing among the pathways and across the physical scales of the energy system as well as

Energy systems integration is more than a trend. It is a critical research and development area that will underpin the energy system of the future.

between the energy system and other systems such as data and information networks. Energy systems integration (ESI) enables the effective analysis, design, and control of these interactions and interdependencies along technical, economic, regulatory, and social dimensions. By focusing on the optimization of energy systems across multiple pathways and scales, we can better understand and make use of potential co-benefits that increase reliability and performance, reduce cost, and minimize environmental impacts.

JISEA and its partners recognize the growing importance of ESI as a critical multidisciplinary, multifaceted research and development area that will underpin the energy system of the future. We support NREL's development of a core competency to drive the development of the next generation of systems integration, simulation, operation, and controls and inform future energy system architectures, policies, and investments. NREL is assembling critical analytical and physical capabilities to address ESI with investments in the new, state-of-the-art Energy Systems Integration Facility and national and international work to highlight challenges and opportunities.

Headquartered on NREL's 327-acre campus, JISEA benefits from access to NREL's researchers and research facilities, including the Energy Systems Integration Facility. This Energy Department user facility is the nation's first to help both public and private sector researchers scale up promising clean energy technologies and test how they interact with each other and the grid at utility scale.





LEARN MORE
www.nrel.gov/esi

The convergence of energy disciplines, environmental factors, and economic challenges is demanding a new focus on world energy goals and how we will meet them. With the ability to tap into NREL's innovative laboratories and assemble teams from leading universities and partner institutions, JISEA is working to advance the science of energy systems integration.

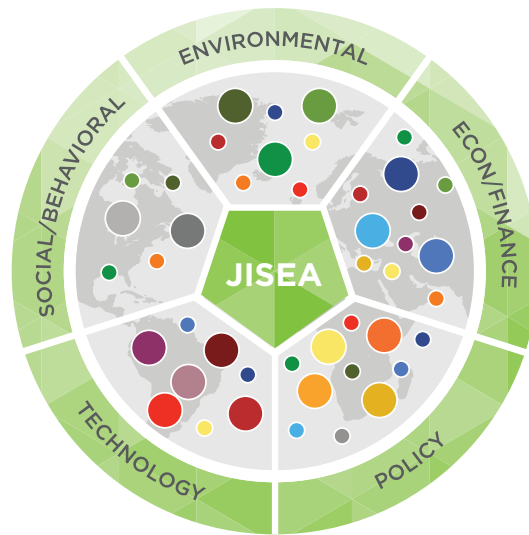
RESEARCH AWARDS

ENCOURAGE UNIQUE PERSPECTIVES

Through the Innovative Research Analysis Award Program (IRAAP), JISEA has provided nearly \$1 million to research teams drawn from JISEA partner institutions for collaborative, multidisciplinary energy analysis projects.

PUBLISHED AS PEER-REVIEWED JOURNAL ARTICLES AND TECHNICAL REPORTS, RESEARCH FUNDED THROUGH JISEA'S IRAAP PROGRAM:

- Emphasizes the environmental, economic and financial, policy, technological, and social and behavioral aspects of energy systems
- Encompasses an integrated systems perspective
- Considers the implications of findings in economic, social, and environmental terms
- Applies at local, domestic, and international scales
- Leads to significant global impacts on energy sector transformation.



- Energy H₂O Nexus
- Energy and Water
- Marginal Lands
- Financial Models
- GIS Optimization
- Ancillary Markets
- Model Integration
- Waste to Energy
- Sustainability Analysis
- Energy-Specific Models
- Microgrids
- CO₂ Mineralization
- Nuclear and RE
- Lo-Temp Geothermal
- Hydropower
- High RE and DR
- EE Retrofits

Our balanced portfolio of projects emphasizes environmental, economic and financial, policy, technological, and social and behavioral aspects of energy systems. The projects also range in geographic scope.

IRAAP PROJECTS WITH ENVIRONMENTAL EMPHASIS

Energy-Water Nexus in a Drying West: A Case Study Analysis and Methodology

COLLABORATORS

Colorado State University, University of Colorado at Boulder, NREL

RESEARCH GOAL

Inform long-term energy and transmission planning strategies.

Toward an Improved Methodology for Comparing Water-related Impacts of Electricity Generation: A Preliminary Analysis of Concentrating Solar Power Data

COLLABORATORS

Stanford University, University of Colorado at Boulder, NREL

RESEARCH GOAL

Develop more comprehensive and accurate water quality and water quantity metrics for use by energy system planners and regulators.

Renewable Energy Potential on Marginal Lands in the United States

COLLABORATORS

Stanford University, NREL

RESEARCH GOAL

This study, the first to take a detailed look at U.S. marginal lands and their potential for renewable energy development, provides policymakers and industry developers with valuable information to guide strategic decisions.

JISEA'S GLOBAL TEAM



Patricia Statwick

Program Administrator

Patricia Statwick works to develop, implement, and manage JISEA programs, including the Innovative Research Analysis Award Program. She provides project management assistance for projects ranging from topical scoping studies to international program operations. Statwick recently received a master of applied science degree in environmental policy management, with a concentration in energy and sustainability, from the University of Denver. She has an MBA from Northwestern University and a bachelor of arts from the University of Notre Dame.

» CONTINUE

IRAAP PROJECTS WITH TECHNOLOGY EMPHASIS

Verifiable Decision-making Algorithms for Reconfiguration of Electric Microgrids

COLLABORATORS

Colorado State University,
University of Colorado at Boulder

RESEARCH GOAL

Discover new algorithms for reconfiguration of electric power microgrids in order to accelerate the penetration of renewables in the grid.

Impact of Alkalinity Sources on the Life Cycle Energy Efficiency of CO₂ Mineralization Technologies

COLLABORATORS

Massachusetts Institute of Technology, Stanford University

RESEARCH GOAL

Assess the usefulness of several potential alkalinity sources, providing findings usable in life cycle assessments of mineralization-based CO₂ capture systems.

A Combined Nuclear and Renewable Solution to Decarbonizing the Electric Sector

COLLABORATORS

Colorado School of Mines, NREL

IN-KIND COLLABORATOR

University of Wisconsin at Madison

RESEARCH GOAL

Investigate the potential compatibility of a high renewable energy grid with load-following nuclear power plants.

Integration of Low-Temperature Geothermal Resources with Other Power Generation Technologies to Improve System Performance and Resource Utilization

COLLABORATORS

Colorado State University, NREL

RESEARCH GOAL

Using a techno-economic analysis, identify promising applications for low-temperature geothermal resources.

Improving Hydropower Operational Models for Integrating High Penetrations of Renewable Energy

COLLABORATORS

University of Colorado at Boulder, NREL

RESEARCH GOAL

Explore the contribution that a more accurate representation of hydropower could have to the electric system and the integration of variable generation.

IRAAP PROJECTS WITH ECONOMIC AND FINANCIAL EMPHASIS

Financial Models for Electric Utility Market Transformation

COLLABORATORS

Colorado State University, NREL

IN-KIND COLLABORATOR

Rocky Mountain Institute

RESEARCH GOAL

Identify the business models that utility customers are using to support distributed generation (DG), and quantify the effect of DG on traditional utility business models.

A GIS-based Mapping and Optimization Tool to Aid Siting, Design and Assessment of Utility Scale Energy Development

COLLABORATORS

NREL, Stanford University

RESEARCH GOAL

Develop a proof-of-concept, Web-based GIS tool that evaluates multiple user-defined criteria in an optimization algorithm to inform site selection decisions.

Emerging Ancillary Service Markets in Non-restricted Regions of the Western Power Grid

COLLABORATORS

University of Colorado at Boulder, NREL

IN-KIND COLLABORATOR

RASEI

RESEARCH GOAL

Provide advanced technical, market, and legal-regulatory analysis of needs and barriers with respect to the proposed regional energy imbalance market for the western interconnection.

IRAAP PROJECTS WITH POLICY EMPHASIS

Creation of an Energy Specific Computable General Equilibrium Model to Analyze State Level Policy

COLLABORATORS

Colorado State University, NREL

RESEARCH GOAL

Create a computable general equilibrium model that can help state and federal decision makers assess far reaching impacts of investments in different energy technologies.

Waste Not, Want Not: Analyzing the Economic and Environmental Viability of Waste to Energy Technology for Site-specific Optimization of Renewable Energy Options

COLLABORATORS

University of Colorado at Boulder, NREL

RESEARCH GOAL

Investigate the environmental, policy, economic, and technical factors that have contributed to the success of waste-to-energy technology abroad, and consider how these factors impact the adoption of the technology in the United States.

Multi-metric Sustainability Analysis

COLLABORATORS

Colorado School of Mines, NREL

RESEARCH GOAL

Create a visual tool to compare energy options by social, environmental, and economic factors that vary by locality.

Distributional and Efficiency Impacts of Clean and Renewable Energy Standards for Electricity

COLLABORATORS

Massachusetts Institute of Technology, NREL

RESEARCH GOAL

Combine a “top down” computable general equilibrium model and a “bottom up” electric-sector model to analyze the efficiency and distributional implications of a clean energy standard policy in the U.S. electric power sector.

IRAAP PROJECTS WITH SOCIAL AND BEHAVIORAL EMPHASIS

Power System Balancing with High Renewable Penetration: The Potential of Demand Response in Hawaii

COLLABORATORS

Massachusetts Institute of Technology, NREL

RESEARCH GOAL

Using advanced modeling techniques and benchmarks for best practices in program design, examine cost effectiveness of demand response for balancing intermittent supplies.

Accelerating the Pace of Residential Energy Efficiency Retrofits

COLLABORATORS

Massachusetts Institute of Technology, NREL

RESEARCH GOAL

Construct a model that predicts which homes might be good candidates for energy retrofit based on home heating costs.



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[JISEA.org/iraap_about.cfm](https://jisea.org/iraap_about.cfm)

JISEA'S GLOBAL TEAM

JISEA IS OPERATED BY THE ALLIANCE FOR SUSTAINABLE ENERGY, LLC, ON BEHALF OF ITS FOUNDING PARTNERS.



PROGRAM COMMITTEE

JISEA's Program Committee provides guidance on program direction to the executive director and reviews and approves JISEA's research agenda, priorities, and annual research program plan.

Edward J. Balistreri

Associate Professor, Colorado School of Mines

UNIQUE PERSPECTIVE

Prior to his entry into academics, Balistreri worked as an economist for the United States International Trade Commission. His numeric simulation models of economic policy have been used to analyze global climate policy and commercial policy.

William Boyd

Associate Professor of Law, Colorado State University

UNIQUE PERSPECTIVE

Boyd serves as senior advisor and project lead for the Governors' Climate and Forests Task Force, a collaboration between 17 states and provinces from Brazil, Indonesia, Mexico, Nigeria, Peru, and the United States that is working to develop regulatory frameworks to reduce emissions from deforestation and land use.

Gian Porro

Laboratory Program Manager—Energy Analysis, NREL

UNIQUE PERSPECTIVE

Porro oversees NREL's entire portfolio of analysis for the Energy Department's Office of Energy

Efficiency and Renewable Energy—including frameworks to enable comparison of R&D investments, and national-level policy analyses.

John Reilly

Co-Director, MIT Joint Program on the Science and Policy of Global Change, Massachusetts Institute of Technology.

UNIQUE PERSPECTIVE

Reilly integrates global economic models with models of biophysical systems including the ocean, atmosphere, and terrestrial vegetation. The goal: inform climate policy by illuminating the complex interactions of human society with our planet.

Ron Sega

Vice President and Enterprise Executive for Energy and the Environment and Woodward Professor of Systems Engineering, Colorado State University

UNIQUE PERSPECTIVE

Sega can claim a truly unique perspective of earth—from space. A former astronaut, Sega flew two missions on Space Shuttle Discovery and on a docking mission between shuttle Atlantis and the Mir space station.

John Weyant

Professor of Management Science and Engineering, Director of the Energy Modeling Forum (EMF) and Deputy Director of the Precourt Institute for Energy Efficiency, Stanford University.

UNIQUE PERSPECTIVE

Weyant has been a convening lead author or lead author for the Intergovernmental Panel on Climate Change for chapters on integrated assessment, greenhouse gas mitigation, integrated climate impacts, and sustainable development.

RESEARCH AFFILIATES

JISEA augments the capabilities of its founding institutions with those of leading analysis centers across the globe.

Eskom

ESKOM.CO.ZA

Eskom—Africa's largest electricity producer—generates, transmits, and distributes electricity to industrial, mining, commercial, agricultural, and residential customers and redistributes in South Africa and the region.

International Institute for Applied Systems Analysis

IIASA.AC.AT

IIASA researchers—200 mathematicians, social scientists, natural scientists, economists, and engineers—develop assessment and decision-support

methodologies, global databases, and analytical tools to study energy and climate change; food and water; and poverty and equity.

KTH Royal Institute of Technology

KTH.SE/EN

At KTH, Sweden's largest, oldest, and most international technical university, education and research spans from natural sciences to all the branches of engineering and includes architecture, industrial management, and urban planning.

Masdar Institute of Science and Technology

MASDAR.AC.AE/INDEX.PHP

Located in Abu Dhabi and established in collaboration with the Massachusetts Institute of Technology, the Masdar Institute is the world's first graduate-

level research-driven university focused on advanced energy and sustainable technologies that remains dedicated to providing real-world solutions to issues of sustainability.

Renewable and Appropriate Energy Laboratory (RAEL)

RAEL.BERKELEY.EDU

RAEL—a research, development, project implementation, and community outreach facility based at the University of California, Berkeley—focuses on systems-level analysis of integrated sustainable energy systems and on the decarbonization of energy networks.

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JISEA.org/about.cfm

REPORT CARD

JISEA'S INCREASING IMPACT

SELECT PUBLICATIONS

"Decision-making for High Renewable Electricity Futures in the United States."

Accepted for publication in *Energy Strategy Reviews*.



"Renewable Energy Potential on Marginal Lands in the United States."

Renewable and Sustainable Energy Reviews. January 2014.



"Power Systems Balancing with High Penetration Renewables: The Potential of Demand Response in Hawaii."

Energy Conversion and Management. December 2013.

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Published by IEA-RETD.



Waste Not, Want Not: Analyzing the Economic and Environmental Viability of Waste-to-Energy (WTE) Technology for Site-Specific Optimization of Renewable Energy Options

JISEA technical report.

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"Interactions, Complementarities and Tensions at the Nexus of Natural Gas and Renewable Energy" #1 in the "Top 25 Hottest Articles" in *The Electricity Journal* during early 2013.

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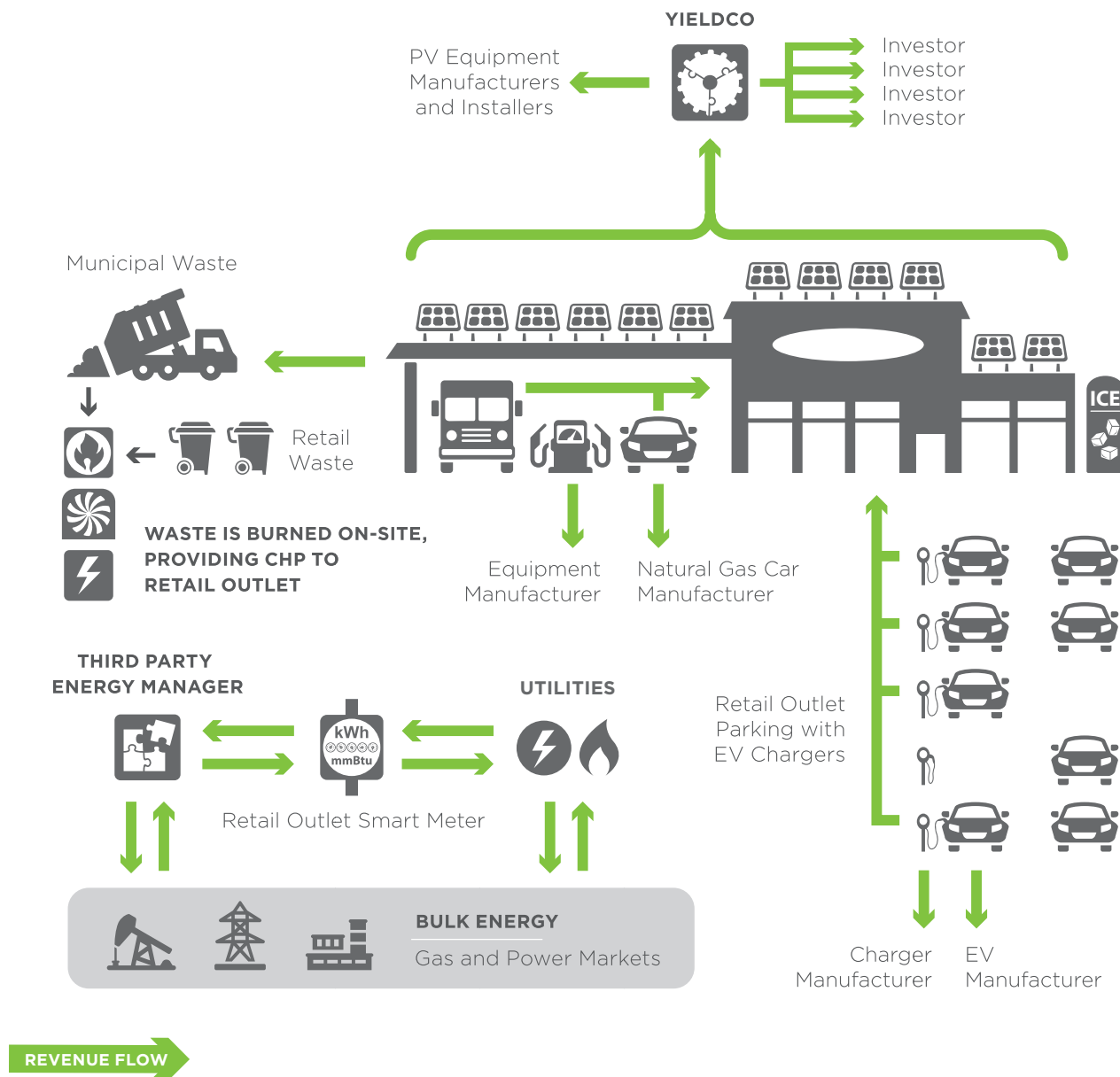
Research funded through JISEA IRAAP program. **Learn more on page 12.**

ON THE GLOBAL STAGE

Doug Arent participated in a panel discussion at the Global Green Growth Summit 2013, which focused on the nexus of finance, innovation, and policy. Arent also presented at the Renewable Energy Finance Forum (REFF) West conference.

Morgan Bazilian contributed a foreword to the *World Economic Forum's Global Energy Architecture Performance Index Report 2014*. He joined the editorial board of *Energy Research and Social Science* and the Japan Renewable Energy Foundation's Innovation Network.

JISEA and the Colorado Center for Renewable Energy Economic Development led a discussion on challenges and opportunities of early stage energy investing at NREL's Industry Growth Forum 2013.

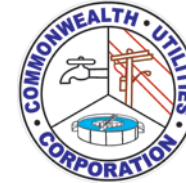


JISEA's research on energy solutions that include both natural gas and renewable energy garnered coverage in the New York Times, the Washington Post, Scientific American, USA Today, National Public Radio, and many other mainstream and scientific media outlets. This illustration from a 2014 published report shows potential revenue opportunities for retail stores, utilities, energy providers, car manufacturers, municipal waste firms, and many other businesses and service providers.

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